Toward an Innovation Management Framework: A Life-Cycle Model with an Idea Management Focus

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***Abstract*—In a turbulent and more competition-oriented environment, organizations need to develop their ability to adapt quickly. To be able to adapt, an organization must, of course, enhance its innovativeness and successful innovation requires to be planned carefully. Even if some researchers treat the early stages of innovation as "fuzzy" because of their uncertainty, others suppose that well structured processes must be used and we agree with this last view.**

This paper presents a theoretical construct, defined as a new idea management lifecycle that aims to support all activities of the Front End of innovation, from insight to idea validation. This lifecycle consists of four key parts: four stages, followed by decision points "Gates", knowledge engine that enable learning to occur and flow, and contextual factors to keep alignment with organization's strategy, goals, needs... Next, a new innovation lifecycle that cover all the innovation activities was introduced. This innovation lifecycle forms the basis of a new emerging innovation management framework.

***Index Terms*—Innovation management, idea management, life cycle, creativity & knowledge, collaboration & learning.**

I. Introduction

Innovation is currently recognized as an essential competitive enabler for any organization that wants to survive and grow. According several surveys, such the annual innovation survey from The Boston Consulting Group, an increasing number of organizations spend more and more on innovation, but many of these initiatives don't generate satisfactory profit or competitive advantage. This problem does not lie in a lack of ideas, but more in a successful management of the innovation process from an idea to a used product. Booz Allen Hamilton found that a common factor between successful innovators is "a rigorous process for managing innovation, including a disciplined, stage-by-stage approval process combined with regular measurement of every critical factor, ranging from time and money spent to the success of new products in the market" [1]. This seems to be in stark contrast to the traditional wisdom that believes that inventions cannot be planned, but require innovative and free thinking only.

On the other hand, if there are quite a lot of solutions for innovation management, few of them provide features dedicated to the previous and crucial stage of emergence of ideas. However, many authors have for many years shown the importance of these early stages in the ultimate success of an innovation [1].

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This paper is organized as follows. First, to bring better understanding of the topic, we discuss the innovation concept through different points of view and we introduce the idea management emergent concept (Section II). Next, in Section III, we highlight the main characteristics that we believe fundamental for the success of the innovation management process. Then, we review the existing models for innovation and early design phases and we provide a synthesis of important learning gathered (Section IV). Section V and VI present our idea management and innovation management lifecycles, developed from combined learning, before we conclude in Section VII.

II. Innovation Management

The phenomenon of innovation is not new, in pre-historic times, mankind was able to turn ideas into realization and over time, countless innovations were developed. But, the body of literature around the topic of innovation management is relatively young.

A. Definition and Meaning

Schumpeter was probably the first modern theorist of innovation. He defines innovation as the introduction of new products, the introduction of new method of production, the opening of a new market, the conquest of a new source of supply of raw materials and the carrying out of the new organization of any industry [2]. This definition is particularly interesting because it defines innovation as a process and not only as an object, by using the term "introduction". This definition shows also an advanced understanding of innovation because it is not limited only to the product innovation, but opens the door to organizational innovations or still to process innovations.

B. Idea Management

The innovation as a process starts with capturing ideas from employees and then evaluating them in order to determine which ideas have the greatest potential to add value to the organization. This front-end part of the innovation process, called "Idea management process", is based essentially on the generation of new concepts, by combining organization's knowledge and collective intelligence, aligned by the organization's contextual factors (strategy, goals, needs...). This paper seeks to provide new answers to the issues related to this emerging field of research.

C. Invention vs Innovation

If the goal of innovation is positive change, this change must increases added value. The UK Department of Trade

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and Industry (DTI) define innovation as the successful exploitation of new ideas [3]. Thus, according to economists, implementation and exploitation are also important parts of the innovation process [4], [5]. In this framework, Freeman explains the distinction between invention and innovation as follows: "An invention is an idea, a sketch or a model for a new or improved device, product, process or system (...). An innovation in the economic sense is accomplished only with the first commercial transaction" [6]. From this description, we will talk about idea until achieving its implementation, about invention until its first exploitation and after about innovation.

III. Key Concepts

In this section we will discuss the key concepts that characterize the innovation.

A. Innovation and Creativity

All innovation begins with creative ideas. According to Muirhead, a basic definition of creativity is the ability to produce novel (original/unexpected) work that is high in quality and is appropriate (useful) [7]. Wyckoff defines creativity as new and useful. Harris states that creativity is first of all ability, the ability to imagine or invent something new. Creativity is not the ability to create something out of nothing (only Allah can do that). Rather, it is the ability to generate new ideas by combining, changing, or reapplying existing ideas. Secondly, creativity is an attitude, the ability to accept change and newness, a willingness to play with ideas and possibilities, a flexibility of outlook, and the habit of enjoying the good while looking for ways to improve it. Thirdly, creativity is a process, the process of turning new and imaginative ideas into reality by making gradual alternations and refinements through continuous hard working [8]. This definition highlights the multidimensional aspect of creativity, while stressing that individuals should realize that it involves hard work and a flexible mental attitude.

As reported by Amabile & al., "All innovation begins with creative ideas. We define innovation as the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation; the first is a necessary but not sufficient condition for the second".

B. Innovation and Knowledge

Nonaka & Takeushi based on the work of Polanyi, define knowledge as composed of two dimensions, tacit and explicit:

1) Tacit dimension, based on experience, thinking, and feelings in a specific context, and comprised of both cognitive and technical components. The cognitive component refers to an individual's mental models, maps, beliefs, paradigms, and viewpoints. The technical component refers to concrete know-how and skills that apply to a specific context [9].
2) The explicit dimension of knowledge, articulated, codified, and communicated using symbols [9].

Thus, innovation can be defined as the process that combines ideas and knowledge into new value by allowing individual and organizational knowledge to be exposed, assimilated, shared and finally transformed to produce new knowledge. Therefore, the systematic development of new knowledge, produce innovations and it is this continuous interaction of knowledge and ideas that will define the organization's capacity to innovate and consequently to prosper in an increasingly competitive environment.

C. Innovation and Collaboration

The transformation of an idea into a product, process or service is carried out through a wide range of knowledge. This implies an interaction between the different actors at the heart of this process and between different disciplines.

People as the core of innovation, their insights, concerns, and desires shape the pursuit of new ideas, and the decisions that need to be made during the process of transforming these ideas into value. Consequently, managing innovation is largely a process of managing people, and also managing the principles and practices according to the way their work is organized, that means managing their collaboration process.

Innovation as a social process, happens when people interact with others, but requires a great deal of thought, planning, and preparation.

D. Innovation and Learning

The learning process is viewed as an ongoing sense making activity based on the collective knowledge of the individuals; Stata describes learning as "… the process by which individuals gain new knowledge and insights and thereby modify their behaviors and actions" [10]. Some researchers argue that experience is all that is needed for learning to occur; others, such as Dewey, proposed that learning is an ongoing "reconstruction of experience" that reconciles new experiences with old ones in a continuous learning process [11]. Kolb defines learning as "the process whereby knowledge is created through the transformation of experience," [12] Therefore, learning means integrating new knowledge or mixing existing knowledge in different ways, learning leads to newness, and thus to innovation.

Talking about learning led us to talk about organizational learning that is defined as a collaborative effort where individuals create new ideas by sharing their knowledge through interaction with others. The link between individual learning and organizational learning is one of the most debated subjects in the literature regarding organizational learning. Some researchers, such as Senge, claim that "organizational learning is the product of individuals' learning", while others, such as Simon, appreciate the fact that organizational learning is more than the sum of the members' individual learning in an organization [13]. In our work we agree with this last view.

Thus, for organizations that seek to have competitive advantages, to innovate, to have performance, to possess an intellectual capital to face the challenges of the actual society, to have the capacity to adapt, they need to implement a process of learning at organizational level.

E. Summary

Following the above discussion, we can synthesize that all these dimensions -creativity, knowledge, collaboration and

learning- are interlinked (Figure below), but a good performance at one is not automatically a consequence of good performance at one or several of the other dimensions.

Furthermore, from a strategic perspective, these dimensions and the positive or negative links between them will be affected by contextual variables.

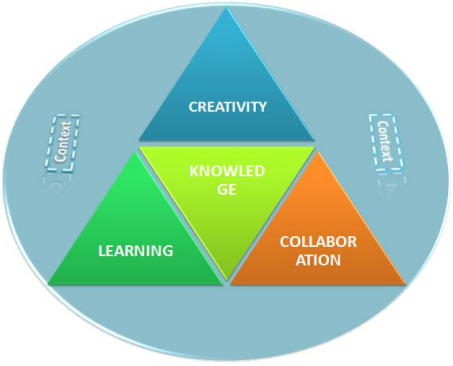

Fig. 1. Innovation's dimensions.

IV. Literature Review of Process Models

The definition of successful innovation had long been the concern of several researchers, which has led to several models of process to manage innovation. In the following subsections, we will review and discuss some process models with the goal of understanding their strengths and weaknesses.

A. Overview of the Process Models

An overview of the most widely recognized process models that focus on the front end of innovation is summarized in Table I.

B. Discussion

As mentioned earlier (Section III), a successful innovation must consider a set of characteristics. The main characteristics highlighted above are:

1) Link to creativity management.
2) Link to knowledge management.

TABLE I: Overview of the Process Models

Model	Stages	Features
Khurana & Rosenthal (1998) [14] Holistic Approach	1. Preliminary Opportunity Identification[1] 2. Product Concept Definition 3. Product Feasibility and Project Planning.	- Emphasizes the importance of a structured strategy for dealing with development of a new product. - Distinct between strategic level foundation elements and project-specific elements. - Full process includes NPD[2] Execution phase.
Montoya-Weiss & O'Driscoll (2000) [15] *Funnel Model*	1. Idea Qualification 2. Concept Development 3. Concept Rating 4. Concept Assessment	- Not a full process, but a process model for dealing with ideas - Adopts idea management software as a key tool to guide the process. - Integrates the concept of idea banks.
Koen *et al.* (2001) [16] *NCD Model*	1. Opportunity identification 2. Opportunity analysis 3. Idea generation and enrichment 4. Idea selection 5. Concept definition	- Introduces external influencing factors - Its center "Engine" witch drives activities is fueled by leadership, culture and strategy - Consists of elements instead of processes emphasizing the iterative and non-linear nature of early stage activities - Full process includes the NPPD[3] and the commercialization phases.
Husig, Kohn, & Poskela (2003) [17] *Process Model*	1. Environmental screening 2. Idea generation 3. Concept project and Business planning	- Gives a representation of continuous activities that permanently go on in order to fill the NPD pipeline. - Provides structured formalization of the early stages - Early stages are followed by a gates - Full process is completed with NPD-process (Development & Market launch).
Griffith-Hemans and Grover (2006) [18] *Idea Fruition Process*	1. Idea creation 2. Idea concretization 3. Idea commitment	- An iterative process - Concretization phase seeks making the idea acceptable rather than progressing toward a prototype - Shows that Individual idea originator and organizational factors both influence the degrees of creativity, concretization, and commitment.
Hansen and Birkinshaw (2007) [19] *Innovation Value Chain*	1. Idea generation 1. In-house idea Generation 2. Cross-pollination 3. External sourcing 2. Idea conversion 4. Selection 5. Development 3. Idea diffusion	- Not so much a process flow model, but gives a holistic overview of innovation - Presents the major activities which should take place as an idea moves towards market launch - Describes idea generation as an area in which ideas are created or obtained - Highlights the multiple sources of ideas.
Cooper (2008) [20] *Stage-Gate Model*	1. Discovery 2. Scoping 3. Build business case 4. Development 5. Testing and validation 6. Launch	- Consists of a Set of Information-Gathering Stages followed by Go/Kill Decision Gates - Helps to guide development and eliminate poor projects. - Seeks to balance risk and expenses.
Westerski & al. (2011) [21] *GI2MO Life Cycle*	1. Idea generation 2. Idea improvement 3. Idea selection 4. Idea implementation 5. Idea deployment	- Covers the major activities of an innovation process - Aims using semantic web technologies to interconnect data - Shows the dependencies between the community-created information and the enterprise processes.

3) Link to collaboration management and team building.
4) Link to learning management.
5) Interaction with the organization's context.

Relatively to these characteristics, a good process for managing innovation should also enable:

6) Link to ideas bank.

[1] Includes market and technical assessment; in parallel with the product and portfolio strategy evaluation

[2] New product development

[3] New Product and Process Development

7) Account for feedback and iteration.
8) Formal integration of gates.

Based on these 8 characteristics we evaluated the process models presented above. The table below presents a summary of this evaluation.

TABLE II: THE COMPARISON OF THE PROCESS MODELS

Model/Criterion	C 1	C 2	C3	C4	C5	C6	C7	C8
Holistic App.	√	×	×	×	√	×	√	×
Funnel Model	×	×	×	×	×	√	×	×
NCD Model	×	×	×	×	√	×	√	×
Process Model	×	×	×	×	√	×	×	√
Fruition Process	√	×	×	×	√	×	√	×
Value Chain	√	×	×	×	×	×	×	×
Stage-Gate	×	×	×	×	√	×	×	√
GI2MO	√	√	×	×	√	√	√	×

We observe that the bulk of these process models do not respond or respond poorly to the defined characteristics.

So, our aim is to develop a new model, that provides innovative answers to the weaknesses found in existing models.

V. IDEA MANAGEMENT LIFE CYCLE

Based on the main concepts highlighted in the previous section, this section will present a new lifecycle model that focus on the earliest stages of innovation process (Figure below). The main aim of this lifecycle is to manage idea from its emergence until it's moving towards the project phase or its abandonment. So this is a new idea management lifecycle.

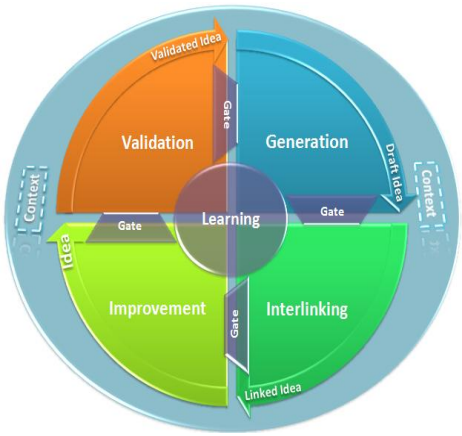

Fig. 2. Idea management life cycle.

Although the lifecycle stages appear successive, activities within these stages can overlap. Feedback loops are possible between different stages. The model therefore joins flexible process models more than linear ones.

Various activities that could be occurring in the different stages of this lifecycle model will be more detailed in the following subsections.

A. Generation Stage

The stage of idea generation also called "ideation", whose objective is individual or collective identification of new ideas or opportunities, is often recognized as one of the highest leverage point for an organization [22]. This first pillar of the innovation process is essential because without ideas, or rather without good ideas, there are few chances to have an innovation that can drive growth of organization. The importance of this step is much greater than the risks of failure are many. The especially matters at this stage is to ensure a good presentation of ideas. This stage can be divided into two sub-stages "Creativity step" and "Presentation Step":

1) "**Creativity step**" whose objective is to provide a set of thoughts in key areas of innovation focus from both internal and external sources.
2) "**Presentation step**" whose goal is to formulate an idea from gathered thoughts in order to attract others attention and give them a better understanding that allows them to be able to be part of the idea's development.

To succeed the activities of this stage, several techniques can be defined. For the first sub-stage, the best-known techniques have evolved from "Brainstorming" developed by Osborn (1953) and "Synectics" developed by Gordon (1961), through "QFD method" developed by Akao (1966) and "Mind Mapping" developed by Buzan (1974), and arriving more recently to the "Suggestion Box" that marked the 80th years and "CK theory" initiated in the 60th years by the mathematician Herbert Simon and developed by Hatchuel & Weil in 2000. Below a brief introduction of these techniques:

1) **Brainstorming** [23]: is a collective reflection method that allows, from a working group to find one or many solutions to a given problem. It's based on the principle of free association of ideas and the creative impulse of the participants. The goal of this method is to obtain a sequence of positive mutual associations through sustained discussion of all participants, to generate a maximum of proposals whose judgment and evaluation will occur in later. This technique was invented before all others, so it is also known as "the mother of idea generation techniques".
2) **Synectics** [24]: is a method based on a systematic use of analogies to generate ideas. Analogies are directly or indirectly, the symbolic representation of problems and solution in other areas (e.g. Nature, history, economy ...). Spontaneous remarks of participants are resumed, developed and visualized. Checking their possibilities of realization and returning to the original problem can lead to new solutions.
3) **QFD** (Quality Function Deployment) [25]: This method allows expressing the strategic vision, to get the voice of the customer and translate it into specific products or processes.
4) **Mind Mapping** [26]: is a very powerful graphic technique because it unlocks the potential of the brain; it also helps to express emotions and strengthen memories. Mind mapping technique starts with a single thought, which then incurs more follow-up concepts. At the end, it connects all related thoughts and presents them together as a graph.
5) **Suggestion Box** (Teian in Japanese) [27]: This method inspired by the goal of continuous improvement of Kaizen Japanese technique, allows any employee of the company, whatever his hierarchical level and his qualification, to communicate his thoughts and to make

his new ideas known.

6) **C-K Theory** [28]: The core idea behind C-K theory is to define rigorously a design situation. The first step in C-K theory is to define a brief[4] as a concept, through the introduction of a formal distinction between concept and knowledge spaces; the second step is to characterize the operators that are needed between these two spaces. C-K theory has inspired new management principles for collaborative innovation, with the aim of overcoming the limitations of standard design management methods.

About the second sub-step, while simple textual presentation works well, digital media, such images and sound, can provide additional features; this is still a largely untapped area in idea/innovation management for now. Nevertheless, techniques are emerging as sketching, the storyboard and the storytelling. These techniques are briefly introduced as follows:

1) **Sketching** [29]: refers to a rough drawing of an idea.
2) **Storyboard** [29]: allows illustrated representation of thoughts gained in the creative phase.
3) **Storytelling**: is the application of narrative processes for strengthening adherence of others to his thoughts. This technique fosters a shared understanding regarding future ambitions, can provide inspiration for idea generation and is a mean for thoughts screening and design optimization in the innovation process [Wikipedia].

The inputs of this stage are contextual information (strategy, goals, current needs…) and the gathered thoughts.

The outcome of this stage is a semi-formalized idea that we call **Draft Idea** profile.

B. Interlinking Stage

The purpose of the previous step is to stimulate people's creativity to create innovative ideas even if they are "outside the box", i.e. not aligned with organization's context. But the objective behind the process is to ensure a continuous flow of innovation and not just to collect a large number of ideas. Subsequently, the objective of this step is to allow created ideas to be integrated into the strategic roadmap of the organization, allow ideas creators to be aware of the existing contributors and contributions and allow interested individuals to be involved in the collaboration effort.

This stage allows interlinking between:

1) Idea profile and other profiles of existing deliverables (ideas, inventions and innovations) in order to facilitate the task of finding entities that can serve as a source of inspiration and learning.
2) Idea profile and innovation actors' profiles, according their previous activities and their profiles data, especially their area of expertise, to facilitate finding others may be interested in collaboration to improve or even implement current idea. Finding these others present a significant challenge because it is both difficult to find them and to trust them. So, this stage not only aims finding other interested individuals, but also aims to create relatively trust that allows them to cluster together and work effectively as quickly as possible.

[4]A brief is an incomplete description of objects that do not exist yet and are still partly unknown

In the research area, these issues are not very addressed in the framework of idea/innovation management. Thus, talking about techniques helping to achieve these activities requires openness on other related fields such as knowledge management or linguistic; then, by inspiration and analogy it will be possible to define techniques more specific to our research area. As examples of these techniques we quote:

1) **Latent Semantic Indexing** (LSI) [30]**:** Called LSI because of its ability to correlate semantically related terms that are latent in a collection of text, it was first applied to text at Bell Laboratories in the late 1980s. LSI has proven to be a useful solution to a number of conceptual matching problems. This technique has been shown to capture key relationship information, including causal, goal-oriented, and taxonomic information. LSI has been also used to return the best matching people instead of documents (e.g., Automatic assignment of reviewers to submitted conference papers; people were represented by articles they had written).
2) **Graph-Matching Algorithm** [31], [32]: also called "graph similarity" or "cluster similarity", is based on similarity of several properties in time. This algorithm works on the assumption that the two datasets to interlink should be conformed to the same ontology, or that there is a one-to-one mapping between terms in the first ontology and terms in the second. For applying this algorithm by interlinking the datasets built on the different ontologies, an ontology matching task should first be performed and the resulting correspondences between ontology terms should be included in the algorithm. This algorithm could be extended by using weights.
3) **Graph Mining** [33], [34]**:** is the study of how to perform data mining and machine learning on data represented with graphs. One can distinguish between on the one hand transactional graph mining, where a database of separate, independent graphs is considered (such as databases of images), and on the other hand large network analysis, where a single large network is considered (such as concept networks). Graph mining has been widely used to study relationships among various types of entities (e.g., can be used to determine relevant communities in the network).
4) **Taxonomy** [35]: is a mechanism for structuring the knowledge about a certain domain. It consists of information collection, systematic analysis, and classification of system attributes. It deals with complexity of information by building hierarchical structure of data, wherein any characteristic can be found, used, and updated easily.

The inputs of this stage are idea draft-profile, the profiles of available innovation deliverables (ideas, inventions, and innovations), the actors' profiles and information about the context.

The outcome of this stage is the **idea interlinked** to other innovation deliverables and actors' profiles.

C. Improvement Stage

Idea Improvement is about community building, interaction and collaboration, because in the modern complex

world, where organizations are divided into cross-functional teams, it is very difficult that one person generate and idea and refine it until a formal development project is established. The focus of this stage is to transform the idea into a workable concept through collaboration and this requires a lot of dedication and effort from individuals.

Talking about interaction and collaboration, is talking about participation, collective intelligence, communication, discussion and comments. As example of techniques and technologies supporting these activities and allowing innovation actors to contribute to collective success:

1) **Group Support Systems** (GSS) [36], [37]: also referred to as groupware, are a class of collaboration software used to move groups through the steps of a process toward their goals. They are interactive networked computer information systems that structure, support, and facilitate group interaction. GSS users may work face-to-face or across the globe. Their contributions, anonymous or identified, are available for later recall via group memory embodied in transcript. By allowing parallel communication, GSS permits group members to input their comments simultaneously and see the contributions of others (group memory).
2) **Collaborative Learning Environments** (CLEs): provide a versatile framework designed to create an engaging, collaborative and interactive training environment. They includes rich social networking tools to create a cohesive and engaging place, for remote and local teams to coordinate and communicate, leading to a greater sense of social context and exchange of ideas. Automated assessment and evaluation tools give quantitative feedback on the use and the interaction of teams and members.
3) **Collaborative Virtual Environments** (CVEs) [38], [39]: are virtual spaces or places in which people can meet and interact with others, with agents and with virtual objects. CVEs vary greatly in their representational richness from 3D virtual reality to 2D and even text based environments. The combination of a 3D graphical modeling environment, document and file sharing capabilities, rich text, voice and video communication helps contributors not only to connect better but also to be able to conduct mass collaboration activities and to perform real time simulations. The main applications to date have been military and industrial team training, collaborative design and engineering, and multiplayer games.
4) **Social technologies** (blogs, wikis, social network…): allow people to create, share, collaborate and communicate. They are considered as a key enabler of the novel collaboration era.
5) **Semantic Web**: is about representing meanings, connecting knowledge and putting them into work, in ways that make users' web experience more relevant, useful and enjoyable.

The inputs of this stage are interlinked schemas of idea profile and information about the context.

The outcome of this stage is the complete **idea** profile.

D. Validation Stage

Validation stage is one of the critical steps in innovation management. Assessment should be linked with the organization's context. In case there is no strategic fit, the organization may give the idea to a venturing organization.

This stage concerns the validation of the current idea and also the selection, from the innovation store, of the most promising one to implement. This stage calls for three sub-stages:1) **Metrics definition**, 2) **Assessment** or if required 2) **Selection** and 3) **Decision making**.

Concerning the first sub-stage (Metrics definition), assessment and selection criteria are organization specific and depend on various factors, such as organizational culture, goals and needs, top management's commitment and other parameters such as timetable, budget, applied policies, existing infrastructure, future development plans... Therefore, careful thinking should go into defining them.

The next sub-stage (Assessment) is about further investigation of the idea in order to determine its feasibility. It is better and more cost effective to fail at this stage than later and the concept assessment should be used as a learning experience. In case of choosing an idea from the innovation store, the second sub-stage (Selection) will concern the selection of the most promising idea(s) to pursue in order to achieve the most added value.

At the end of this stage (Decision making sub-stage), a decision will be taken: Idea is valid and then it should be moved to the project stages; Idea should be resourced and further developed or Idea is left and then it should be captured with the reasons for its abandon, documented and stored in the innovation store for future exploitation.

Below, we present some techniques that can support activities at this stage:

1) **Decision Tree** [40]: is a decision support tool that uses a graphic approach to compare competing alternatives, and assign values to those alternatives by combining uncertainties, costs, and payoffs into specific numerical values. It's commonly used in operations research, specifically in decision analysis, to help identify a strategy most likely to reach a goal.
2) **Sticking Dots**: is a group method, based on opinions. It uses a simple procedure to allow members of a small group to vote directly for their idea preferences. The procedure involves giving each group member a fixed number of votes (in the form of self-adhevise, colored dots) and allowing them to allocate the votes in a pre-selected manner, or any manner they desire.
3) **Analytic Hierarchy Process** (AHP) [41]: is a structured technique based on hierarchical approach for dealing with complex decisions. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. It consists of a hierarchy of criteria and sub-criteria cascading from the decision objective or goal. AHP works by developing priorities for alternatives and the criteria used to judge the alternatives. First, priorities are derived for the criteria in terms of their importance to achieve the goal, and then priorities are derived for the performance of the

alternatives on each criterion. These priorities are derived based on pair-wise assessments using judgments, or ratios of measurements from a scale if one exists. A weighting and adding process is used to obtain overall priorities for the alternatives as to how they contribute to the goal.

4) **Delphi** [42]: is a group process used to survey and collect the opinions of experts on a particular subject. This technique is useful where the opinions and judgments of experts and practitioners are necessary.
5) **NAF**: allows scoring based on individuals perceptions of novelty, attractiveness, and feasibility. Each score is set between 1 (lowest) and 5 (highest) and the total score gives then the final ranking.

The inputs of this stage are idea profile and information about the context.

The outcome of this stage is a **validated idea** with one of these decisions: Go to the next stage and get the "roadmap", Go Back to a previous stage for further improvement or No Go and keep track of what was done for later use.

E. Learning Engine

Learning is central to organizational effectiveness, adaptability, innovation and sustainability. While learning is acquired through a cognitive process of reflecting and/or through a behavioral process of doing, learning can be further developed and exploited through a process of applying, spreading and embedding the knowledge. One of the key challenges in innovation management and enhancing organizational creativity is to capture, leverage and utilize the knowledge gathered throughout the whole lifecycle of innovation. Academics, such as Nonaka & Takeuchi, have turned their attention to exploring the rich interplay of feed forward and feedback mechanisms that enable learning to occur and flow between individuals and groups.

In our lifecycle, gathered feedbacks from each stage allow creating valuable knowledge that should be used first in these stages and then stored to enrich the organization's memory and to be used for better managing other ideas in the future. These activities develop the organization's ability to identify, assimilate, and exploit knowledge -what is called organization's 'learning' capacity.

Knowledge management technologies could be a very good support for these activities.

F. Gate

Gates are decision points that are planned to sift the attractive and less attractive ideas. Less attractive ideas and concepts should however be documented and stored for future exploitation. In our lifecycle, every stage is followed by a Gate that permits deciding if Go, Go Back or No Go. Each Gate should have clearly defined criteria by which viability of continuation can be judged.

These Gates allow also integrating retroaction loops in the lifecycle. E.g. from the validation, implementation and exploitation (Both belong to the innovation management lifecycle that will be introduced later) stages, getting back at the interlinking stage to review interlinking between idea/invention profile and the actors' profiles can occur. The purpose successively is to facilitate finding the most suitable reviewers who can provide better assessment, building the most efficient development teams and finding the most suitable experts' profiles to ensure a proper exploitation of the innovation.

G. Context

According to Clegg & al., 90% of IT projects fail to meet their goals due to a misalignment of goals and organizational activities [43]. Thus, innovation that is not in line with the organization's context (strategy, goals and needs, resources and culture, structure and processes…) may fail.

This lifecycle allows capturing ideas in context with the relevant team members and the external considerations, in order to keep a history of new ideas, since many times ideas that are rejected due to current circumstances, can become more viable in the future.

In our lifecycle, all stages are linked and aligned with contextual factors. This emphasizes the innovation network aspect, as well as the open innovation concept – all stages could have external influence, or even outsourced externally.

VI. Innovation Management Life Cycle

Without idea's implementation and exploitation organizations couldn't benefit from their innovativeness, and a competitive edge is not created. Therefore, to cover all the innovation activities from insight to use, another lifecycle proposal "innovation management lifecycle" that extend the above lifecycle will be introduced. The additional stages in this lifecycle will be presented briefly because they join a well covered field by research, who is the project management.

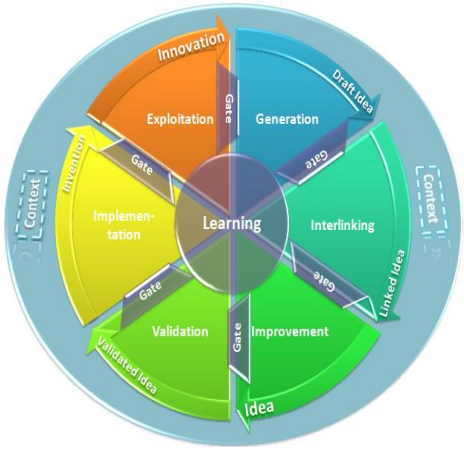

Fig. 3. Innovation management life cycle.

A. Implementation Stage

The implementation stage involves the design, development and testing of the innovation product as identified, conceptualized and decided upon during the previous stages. It includes the detail project planning and management of the design and development project.

The outcome of this stage is **invention**.

B. Exploitation Stage

At this stage the product is exploited through new business

models and markets. The aim is therefore to generate added value. The outcome of this stage is the desired **innovation**.

VII. Conclusion

In this paper, we have presented new lifecycles models proposals for idea and innovation management. For each stage of the idea management lifecycle we have presented some techniques and technologies that can be used to support their activities. Further work should be made to identify the most suitable and appropriate techniques and technologies to adopt, as well as possible improvements to bring to adjust others to our field of research.

The innovation management lifecycle presented in this paper forms the basis of a generic framework we are currently developing. This framework aims to orchestrate collective action and collaborative learning in order to foster innovation, and seeks to be a high-level abstract framework that can be integrated into a multitude of contexts. This framework is based on three main interlinked components: 1) Creative Idea, 2) Context and 3) Actors. Each of these components will be further detailed in future works.

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